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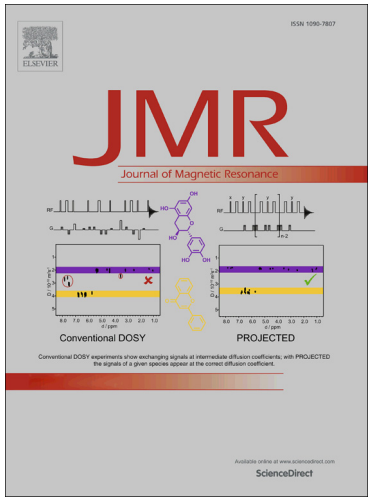

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Topology optimization based design of unilateral NMR for generating a remote homogeneous field

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Abstract

This paper presents a topology optimization based design method for the design of unilateral nuclear magnetic resonance (NMR), with which a remote homogeneous field can be obtained. The topology optimization is actualized through seeking out the optimal layout of ferromagnetic materials within a given design domain. The design objective is defined as generating a sensitive magnetic field with optimal homogeneity and maximal field strength within a required region of interest (ROI). The sensitivity of the objective function with respect to the design variables is derived and the solving method of the optimization problem is presented. A design example is provided to illustrate the utility of the design method, specifically the ability to improve the quality of the magnetic field over the required ROI by searching the optimal structural topology of the ferromagnetic poles. Both in simulations and experiments, the sensitive region of the magnetic field achieves about 2 times larger than that of the reference design, which adequately validates the feasibility of the design method.

Keywords

Topology optimization; Structural design; Unilateral NMR; Homogeneous field.

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